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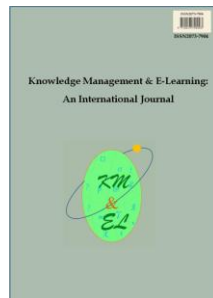
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### **How emotions stimulate people affected by cancer to use personalised health websites**

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## **How emotions stimulate people affected by cancer to use personalised health websites**

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**Abstract:** This paper focuses on helping people affected by cancer – which is the leading cause of death worldwide - by identifying their personalisation needs for health websites. The aim is to identify a set of personalisation features that users prefer on these websites. Delving in a less explored area, the study also seeks to understand how user emotional states correlate with their needs for personalisation, to better define user models for health websites. Through a controlled experiment, based on the survey questionnaire method, we established that participants perceived that personalisation features offered on the evaluated website do meet their needs. More interestingly, perceived personalisation needs are influenced by certain emotions, primarily positively valenced emotions (e.g., interest). Finally, two factors positively impact intentions to reuse the website: personalisation needs and post-usage emotions. The outcomes of this study inform on ways to increase user engagement on health websites and improve online support available to people affected by cancer.

**Keywords:** Cancer websites; Personalisation; Usage intentions; Emotions

**Biographical notes:** Suncica Hadzidedic Bazdarevic is a PhD candidate at the Department of Computer Science (DCS), University of Warwick. She has 3 years of experience as a senior teaching and research assistant at the University Sarajevo School of Science and Technology. Her research interests are in e-health, web personalisation, data analytics, and effect of user characteristics (primarily emotions) on technology usage.

Dr. Alexandra I. Cristea is an Associate Professor (Reader) and Head of the Intelligent and Adaptive Systems research group at DCS. Her research includes user modelling, personalisation, semantic and social web (over 200 papers). She has been a co-chair, organizer, or similar, for various conferences. She led and participated various projects and acted as UNESCO expert, and EU expert for H2020, FP7, FP6 and eContentPlus. She is a BCS Fellow, associate HEA Fellow, IEEE and IEEE CS member.

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## 1. Introduction

Health information is the most sought after information on the Internet (Bright et al., 2005). Yet, the online systems, websites and services providing health content continue to be criticized for the low usability, presentation and usefulness of content (Kushniruk, 2015). One of the ways to increase usability of websites, as well as the likelihood that the provided content will be matched to users' health literacy and situation, is by introducing personalisation (Alpay, Verhoef, Xie, Te'eni, & Zwetsloot-Schonk, 2009). This could lead to more informed patients (Rice, 2006), active in personal healthcare (Huang, Chang, & Khurana, 2012).

Online personalisation, i.e., content tailoring to user's characteristics and needs, has been widely accepted and applied in certain online contexts, such as entertainment, e-learning and e-commerce (Rossi, Schwabe, & Guimarães, 2001). The majority of Internet users desire to be provided personalisation services (Kobsa, 2007). This could be attributed to the many benefits stemming from such services (Riecken, 2000). An important benefit is the improved relevance of presented content (Grasso & Paris, 2011), for which the online health services are often criticised. Despite the advantages of introducing personalisation, no single formula works for all areas (Riecken, 2000). The challenge lies in considering the online context and the specific needs of the target user group.

In this paper, we focus on improving health websites that provide content to a subgroup of users. Specifically, online health resources for users affected by cancer - the disease from which 32.6 million people were suffering in 2012, 14.1. million were newly diagnosed (IARC, 2014), and which continues to have the highest death toll globally (CRUK, 2014). Users of online health services, in particular the cancer-related ones, are atypical. Their characteristics and needs are unique, thus, selecting the *set of user features* to be modelled requires careful consideration. Importantly, the effect a cancer-like disease has on a person's life is not only physical, but also psychological and emotional (Macmillan, 2012). We, therefore, propose that providing health content to such users also entails grasping their *emotional state*.

While major global cancer websites exist, as previously stated, progress in online health services' personalisation is slow. Some health websites have introduced a certain level of personalisation, however, not in a systematic or comprehensive way. Moreover, it is not transparent what characteristics the user models are based on, whether users were engaged in the process of feature selection, and how the decision was made which features to implement. In addition, the health websites in question are mainly commercial endeavours, based on proprietary research, not academic undertakings. One of the essential factors to consider was, also, the online context to set the study in.

Bosnia and Herzegovina (B&H) was selected for several reasons. The target users should be unbiased and unaffected by previous experience with attempts of health website personalisation. The health websites that offer certain personalisation features are U.S. based or from developed European countries. For the purpose of this study, collaboration was established with one of the main cancer associations from B&H, to gain access to their member base and health content from their original website. As preliminary work for this study, the website was redesigned, to incorporate *personalisation features*.

Using B&H as focus for the study has many advantages, including the opportunity to study, from scratch, the introduction of personalisation features. The researchers opted to rebuild the website in order to have access to and make adjustments

to all website functionalities. Moreover, in system evaluations it is then possible to expose users to the full-feature set, and thus obtain comprehensive feedback on which to base the system changes. In addition, such an approach enables expanding the user model with features not currently available on other services – *emotions*.

While the online health resources in English are widely available and accessible, for the majority of people in B&H there exists a language barrier and a preference to search for sources in the native language (Hadzidedic Bazdarevic & Cristea, 2015). However, public health services in B&H are faced with several problems; their reform is still on-going after the 1992-95 war - there is institutional fragmentation, unequal access to and poor quality of health care (FMH B&H, 2012). B&H users have limited access to cancer-related content on the Internet (Hadzidedic Bazdarevic & Cristea, 2015). Moreover, the existing B&H online cancer services have made no attempts at personalising the content to the users' characteristics and needs. Furthermore, while they are clearly needed, no studies in this field have so far been applied to B&H, to the best of our knowledge.

However, while B&H was a convenient, untainted environment needed for extracting the type of personalisation features to introduce to cancer websites in a systematic way, the findings are generally applicable to worldwide online cancer services. As a result of this work, *a set of personalisation features has been identified that users prefer on health websites*. Furthermore, it provides *an understanding how users' emotional states correlate with the needs for personalisation, to improve user models for health websites*. It also *indicates the factors that can predict and influence the intentions for website re-usage*. The aim is to employ the study's findings *to improve online support available to people affected by cancer, and thus increase users' willingness to reuse and engage with these services*.

In the following sections, we first illustrate the study's research model, as well as explore the background of online health services, related studies on personalisation, and give an overview of research on emotions, especially applied to the fields studied here. We then introduce the website that was used for the experimental part of this study. The remaining sections present the significant relations from the research model. Finally, the findings are discussed and concluded in the last two sections of the paper.

## 2. Background work and research model

### 2.1. Health services on the Internet

Health information seeking is one of the primary reasons of Internet usage (Bright et al., 2005; Luo & Najdawi, 2004). While the traditional ways of obtaining health information have come to a stand-still (Kummervold et al., 2008), significant growth in online health information usage has been noticed in European countries in the period 2001 to 2009 (Ek, Eriksson-Backa, & Niemelä, 2013), as well as worldwide (Siliquini et al., 2011).

For Internet users interested in cancer-related content, the availability and variety of online health information presents significant support in easing their physical and psychological ordeal (Xiao, Sharman, Rao, & Upadhyaya, 2014). However, the sheer variety and amount of online information often means health consumers are overwhelmed, and have to look through sometimes irrelevant information (Alpay et al., 2009), which is incomprehensible for their health literacy level (Jucks & Bromme, 2007). This can negatively influence the willingness of users with unique needs, in particular

those affected by cancer, to revisit health websites, or even continue the current visit. Positive impact on re-usage intentions and user engagement can be achieved by addressing the three main points in online health services, namely: *information quality*, *user interaction and personalisation* (Sillence, Little, & Briggs, 2008). The latter is the focus of the presented paper.

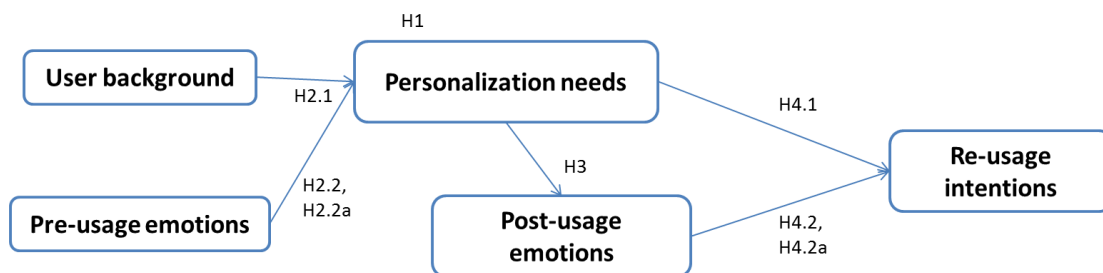
## 2.2. Research model

This study introduces theoretical implications about the usage of personalised cancer-related websites, depending on users' emotional states. The implications are drawn from the relations between the three main factors – *emotions*, *personalisation needs* and *re-usage intentions*. We argue that when a person affected by cancer is searching for information online, their background and emotional state influence the desire to visit a health website, and in turn will influence their needs for personalisation. Moreover, once they engage with a website with personalised services, especially those taking into account users' emotional states, the likelihood of a return visit increases.

The research model used as a basis for this study is illustrated in Fig. 1, and the research questions, referring to people affected by cancer, are:

- RQ1. Do users perceive that personalisation features introduced to a health website (the 24 features studied here) meet their needs?
- RQ2. Do background and emotional state (pre-usage) influence users' perception that their personalisation needs on a health website have been met?
- RQ3. Does a change in users' emotional state occur when using a personalised health website?
- RQ4. Which factors predict the intention to re-use a cancer-related website; are post-usage emotions a predictor?

Five constructs were developed. A brief explanation of each of the constructs is provided in the following sections, including the constituting items and the related hypotheses.



**Fig. 1.** Research model

## 2.3. Online personalisation

The vast majority of Internet users prefer personalised services (Kobsa, 2007). Online health services lag behind in this aspect. Studies (Fernandez-Luque, Karlsen, & Bonander, 2011) report that there are some health websites, primarily U.S. based, which have introduced a level of personalisation, e.g.: TrialX (TrialX, 2012), PatientsLikeMe

(PatientsLikeMe, 2015), Web-based PHRs, Healthy Harlem (Harlem Children's Zone, 2015), WebMD ([www.webmd.com](http://www.webmd.com)), MedlinePlus (MedlinePlus, 2015) and EsTuDiabetes.org ([www.estudiabetes.org/main](http://www.estudiabetes.org/main)). The type of personalisation features focused on are: personalised online health education and personal health records (PHRs), utilization of user profiles (especially on social networks) and clinical trials' recommendations (Fernandez-Luque, Karlsen, & Bonander, 2011). For example, WebMD, a US-based but globally renowned health portal, collaborated with Wellpoint (PRNewswire, n.d.), and expanded their services with personalisation based on member population segmentation (WebMD Health Corp., 2007; Muldoon, 2015).

Nevertheless, one of the main gaps to be addressed in Internet-based health information and services is still personalisation (Sillence, Little, & Briggs, 2008), and personalised interaction (Nijland, 2011), even on major health portals (Luo & Najdawi, 2004). Importantly, the above listed websites are not cancer-specific websites, as studied in this paper. Additionally, these portals miss a wider range of personalisation features, e.g.: personalised content recommendations based on filtering, personalised communication, ratings, wishlists, website layout adaptation, link generation and manipulation.

Furthermore, our review of European online health services, conducted prior to this research (submitted, not published) raises issues with available personalisation. Our state-of-the-art study researches, for the first time - to the best of our knowledge, the availability and necessity of personalisation features on the existing B&H online health services. According to the results, people affected by cancer in B&H would prefer personalisation features on health websites. The research applied to B&H was not done in isolation; similar researches were performed in other countries. SeniorGezond, a health-website for elderly people based in the Netherlands, was used to explore Web-based health support (Alpay et al., 2009). It was shown that user's personalisation needs require a more comprehensive definition, and information that is provided should better reflect user's personal context. Personalisation is, therefore, a challenging task, which does not offer a one-size-fits-all solution. It requires taking the unique set of target user characteristics into account. And, while, in some industries it has been relatively well applied, researching personalisation needs of online health users, especially those affected by cancer, requires more attention.

As a result, we have introduced the factor *personalisation needs*. This self-developed factor measures the level of agreement (5-point Likert scale - strongly disagree to strongly agree) that the personalisation features provided on the evaluated website meet respondents' personalisation needs. In total, 24 personalisation features were evaluated, as hypothesized.

***Hypothesis 1 (H1):*** *People affected by cancer perceive that the personalisation features introduced on the health website meet their personalisation needs.*

#### 2.4. User background

To provide personalised services, a user model has to be developed, based on individual characteristics (Hu & Pu, 2013). The three questions that need to be answered in designing systems with adaptation are: *how*, *when* and *what* to adapt to (Conati, Hoque, Toker, & Steichen, 2013). The latter represents the focus of this paper. User characteristics to adapt to include "stable, long-term user traits (e.g., cognitive abilities, expertise, personality), as well as transitory, short-term states (e.g., current task, cognitive load, attention)" (Conati, Hoque, Toker, & Steichen, 2013). Thus, we introduce the

factors - *user background*, presenting long-term user characteristics, and emotional state, i.e., *emotions*, as the short-term states.

The *user background* construct is employed to categorize participants into a certain demographic group. Items used include: age, gender, and a self-developed multiple-response parameter *how cancer has affected a person's life*. The latter includes 5 categories: Cancer patient, Family member is suffering from cancer, Friend is suffering from cancer, Caregiver to cancer patients, Interested in cancer information but not directly or indirectly affected by cancer, and a None of the above. Hence, based on the research model, we build.

**Hypothesis 2.1 (H2.1):** *Users' background is associated with the perception that personalisation needs have been met.*

## 2.5. Emotions in previous research

While research in personalisation has explored many factors, adaptation to users' emotions remains understudied (Pappas, Giannakos, Kourouthanassis, & Chrissikopoulos, 2013). Certain emotions-related topics were studied within visual judgment, human-computer interaction, e-learning, and online-shopping, such as: affective-priming (Harrison, Chang, & Lu, 2012), fear, surprise, stress recognition (Jang et al., 2012), boredom and pain (Park et al., 2013), sensitivity to happy, neutral, and sad states (Nitin, Rao, & Sivaraman, 2011), and correlation of happiness and anxiety to privacy and personalisation (Pappas, Giannakos, Kourouthanassis, & Chrissikopoulos, 2013). However, to the best of our knowledge, research that focuses on a comprehensive set of basic emotions, applied to personalised health websites, is currently lacking.

It has been shown that cancer triggers negative emotions; people affected by cancer are more likely to feel distressed, depressed, lonely and/or anxious (Shaw, McTavish, Hawkins, Gustafson, & Pingree, 2000). The classification of emotions adopted for this paper was that of the pioneer in emotion research - Paul Ekman. He used facial expressions to identify six basic emotions: *anger*, *fear*, *sadness*, *enjoyment*, *disgust*, and *surprise*, and added other "possible basic emotions", such as *awe*, *contempt*, *embarrassment*, *excitement*, *guilt*, *interest*, *shame* and *enjoyment* (Ekman, 1992). For the purpose of this study, we explored the effect of all the 13 emotions in relation to other research constructs, and report on the relevant findings.

Research has shown that emotions have an effect on 'grabbing' attention, as well as altering it, and that this relation works both ways (Raymond, Fenske, & Westoby, 2005). Our previously mentioned state-of-the-art study suggested that certain basic emotions, specifically: *fear*, *interest*, *sadness*, *surprise*, and *awe*, stimulate cancer information seeking and can predict related Internet usage. The implications of the possible effect of emotions on website usage intentions of people affected by cancer invite further exploration. However, to-date research does not clarify coherently and conclusively the relation between emotions and online behaviour on health websites. This paper, therefore, investigates the relations with emotions from multiple perspectives - their effect on personalisation needs and re-usage intentions, as well as the effect of usage of a personalised health website on the emotional state.

The research model's construct *emotions* (pre- and post-usage) measured the 13 basic emotions, as detailed above and defined by (Ekman, 1992). An 11-point scale was used: 0 – not experiencing the emotion at all, to 10 – experiencing the emotion extremely. The related hypotheses are:



**Hypothesis 2.2 (H2.2):** *There are pre-usage emotions, which positively impact user's perception about a website's ability to meet their personalisation needs.*

**Hypothesis 2.2a (H2.2a):** *Pre-usage emotions can predict a need for specific personalisation features.*

**Hypothesis 3:** *Meeting users' personalisation needs on a health website can result in a change of their emotional state.*

Finally, the **re-usage intentions** factor measured the respondent's intention to revisit /reuse the website with 5 items which were rated on a 5-point Likert scale for agreement. Adopted from other system usability questionnaires (Lund, 2001), the items used are:

- I intend to revisit the 2nd version of PORT's website.
- Given the chance, I intend to use the 2nd version of PORT's website again.
- I intend to use the 2nd version of PORT's website frequently.
- I would recommend the 2nd version of PORT's website to my friends.
- Overall, I have a positive attitude towards using the 2nd version of PORT's website

We hypothesize that re-usage intentions are affected by two factors:

**Hypothesis 4.1 (H4.1):** *People affected by cancer are more likely to subsequently use a health website when they perceive that the features offered on the website meet their personalisation needs.*

**Hypothesis 4.2 (H4.2):** *The emotional state of a user is associated with their subsequent intention to use a health website.*

**Hypothesis 4.2a (H4.2a):** *Users who intend to reuse a health website experience a change in emotional state between pre- and post-website usage.*

### 3. Pilot study and website implementation

The results of our pilot study, mentioned in Sections 2.3 and 2.5, were used as indications of requirements in the development of a personalised health website. We cooperated with a provider of an existing B&H health website – PORT.org.ba (PORT, 2014). PORT is an association that offers an online knowledge base for cancer-related information and an online support community for people with malignant diseases.

Based on the pilot study's findings, the target users desire personalisation features on a health website. Employing these findings, PORT's website was completely redesigned. Fig. 2 is a snapshot of the website after the first phase (Phase I) of development (PORT, 2015).

In Phase I, the content of the original PORT website was migrated to the new website version. A new design and layout were introduced, as well as 24 personalisation features: (1) Background tailoring, (2) User profile customization, (3) Adaptive navigation: Links sorting and (4) Direct guidance, (5) Search outcomes presentation, (6) Adapting text size and (7) colour, (8) Notifications for activities and required actions, (9) Content matched to user's personal interests, (10) Content variety: visual/audio/text, (11) Content in native language (bilingual), (12) Blogging, (13) Use of forum discussions, (14) Greeting with user's name, (15) Forum discussions' recommendations, (16) Blog topics'

recommendations, (17) Articles and news' recommendations, (18) Bookmarks (readlist), (19) Sharing content, (20) Ratings, (21) Commenting, (22) Matching content based on popularity, (23) Categorizing content and (24) Personalised e-mail notifications. Fig. 2 (right image) illustrates selected personalisation features which are available on article-related web pages, including the features: 6 - 11, 14 - 20 and 23.

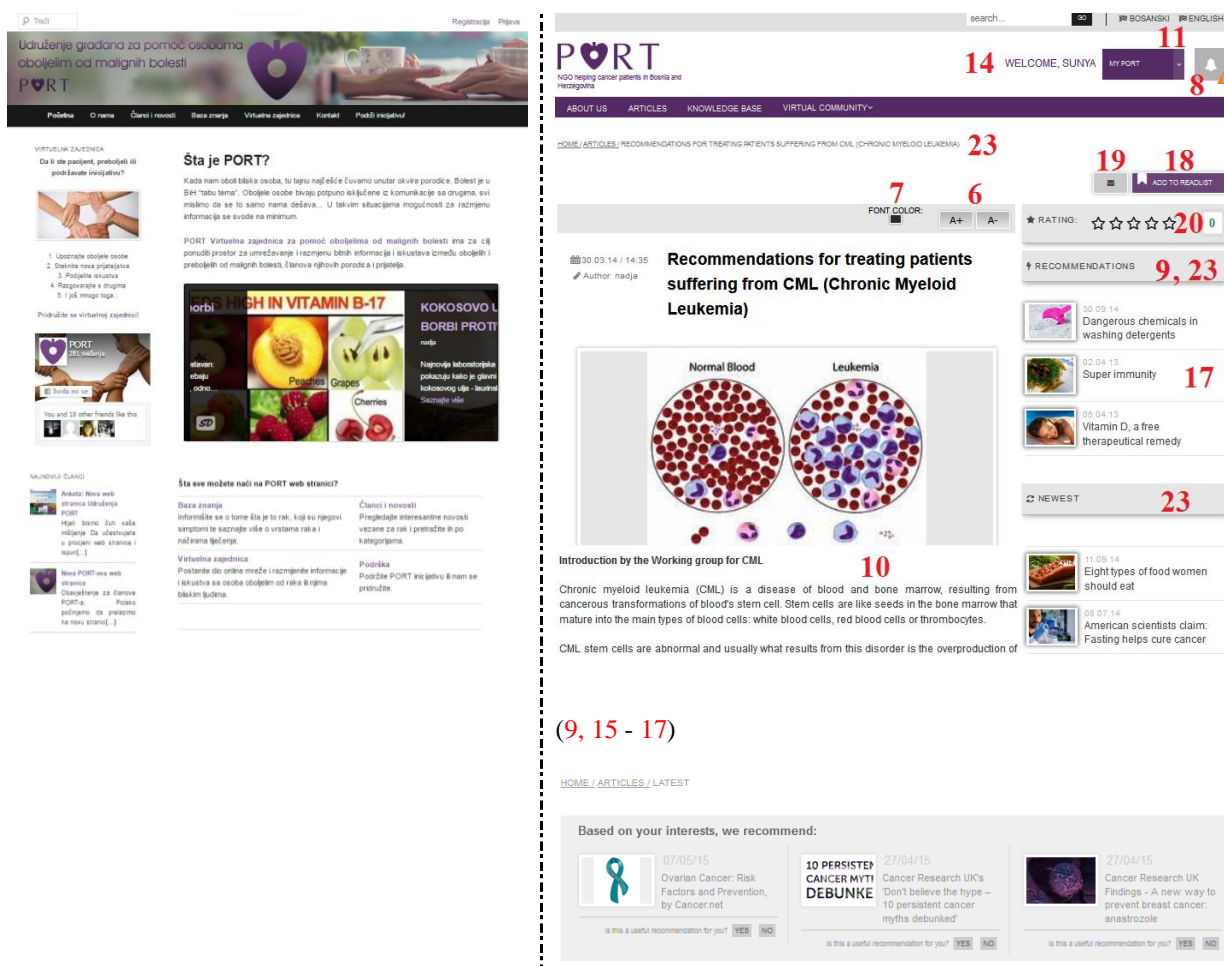


Fig. 2. Appearance of and personalisation features on PORT's original (left) and personalised (right) website version

#### 4. Health website evaluation: Experiment and survey

To answer the research questions, an online experiment was conducted in October 2014. The experiment was advertised via PORT's original website, Facebook and B&H university forums, and distributed during supervised laboratory settings to undergraduate students at the University Sarajevo School of Science and Technology in B&H. Participants were informed about the right to withdraw and objectives of the study, and were given a list of steps to follow:

1. Identify the emotional state they were in, at the start of the experiment.
2. Use the two versions of PORT's website, based on a set of defined consecutive tasks: register, read the privacy policy, edit user profile, use the search, read an article and apply the available features on the web page, use the virtual community – blog and forum, and review profile activities.
3. Fill-out the survey questionnaire, upon completion of step 2.

All the participants were instructed to use both website versions labelled: 'version 1' (the original website) and 'version 2' (the personalised website). This naming was adopted to avoid the potential influence of a website label ('old' vs. 'new') on users' perception about the websites. The same set of tasks, as mentioned in step 2, was specified for both website versions, and both were presented on the same screen/web page. Participants could choose which website version to go to first.

In steps 1 and 3, participants were asked to state to which extent they were experiencing any one of the 13 basic emotions. This question was presented to them within the survey questionnaire, prior to using the website (step 1), and after using the website (step 3) while filling out the remaining part of the survey. The answering of both emotions-related questions was non-compulsory. In addition to collecting data on emotions and background (age, gender, and effect of cancer), participants were surveyed on two other factors from the research model: *personalisation needs* and *re-usage intentions*.

## 5. Analysis and results

Data pre-processing and analysis were performed using IBM SPSS v20 (IBM, 2012). The resulting number of valid responses was 79. The recommended sample size (Raosoft, 2004) for this study was minimum 77, based on a population of 95 registered users<sup>1</sup> on PORT's original website and the assumptions of 95% confidence level, response distribution 50% and error margin 5%.

### 5.1. Reliability analysis

The instrument used to measure the research factors had high reliability. Personalisation needs and re-usage intentions had Cronbach's alpha > 0.9, while the alpha for pre- and post-usage emotions was > 0.8.

### 5.2. Participant data exploration

The average age of respondents was 25.8, with a balanced representation of males (49.4%) and females (50.6%). In reporting on how and whether cancer had affected their life, the majority stated that their family member(s) had cancer (33.3%), or that they were interested in cancer information, but were not (in) directly affected by cancer (33.3%). The difference between the categories of participants, depending on whether and how cancer has affected them was not statistically significant, for any of the factors measured in this study.

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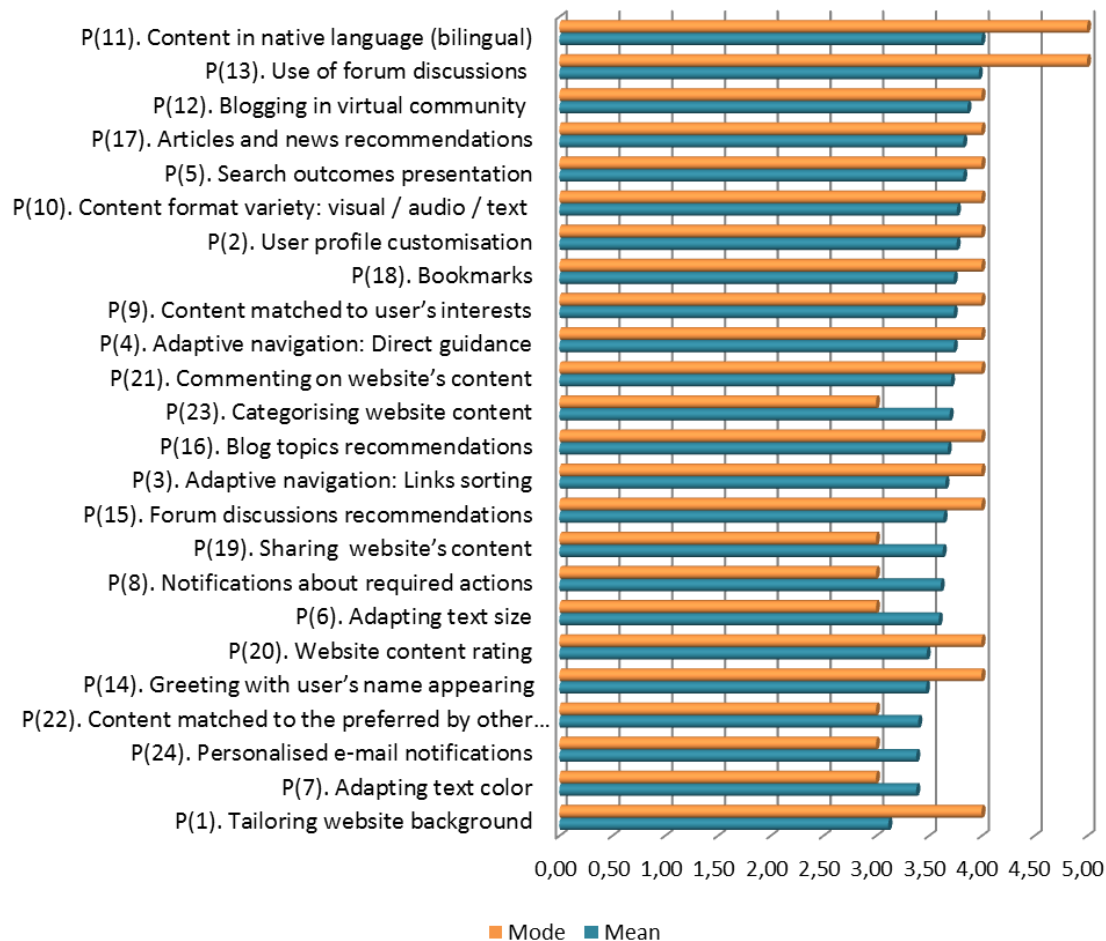
<sup>1</sup> This low number of users is normal for Bosnian health websites, as they are still building themselves up.

### 5.3. Hypotheses testing

Due to a relatively small sample and non-normal data distribution, non-parametric tests were primarily utilized, and the Bonferroni corrections applied, to avoid the family-wise error rate in multiple comparisons (e.g., emotions x personalisation features). In the following sub-sections we provide a detailed overview of the statistically significant results, and a summary of the hypotheses which were not supported.

#### 5.3.1. Hypothesis 1

The mean value for personalisation needs met for the 24 personalisation features offered on the new PORT's website are illustrated in Fig. 3. The average value of the factor *personalisation needs* was greater than 3.6 (standard deviation 0.8). It can be, therefore, inferred that respondents perceived that the personalisation features offered on the 2<sup>nd</sup> version of PORT's website met their personalisation needs, indicating that *H1* is supported.



**Fig. 3.** Level of agreement that personalisation needs were met for the 24 features

Based on the means and modes of the values representing the level of agreement that personalisation needs were met, as assigned to each of the 24 personalisation features, the participants seemed to desire all the features they evaluated on PORT's new website (Fig. 3). The minimum mean value was 3.12, which is above the neutral 3 - neither meeting nor not meeting the personalisation needs. However, 7 of the 24 features (Fig. 3) were most frequently rated with 3, these being: P(6), P(7), P(8), P(19), P(22), P(23) and P(24). Follow-up studies will look into whether these results are due to users' lack of interaction with the features (inability to notice and use them on the website), or the lack of preference in being provided the specific personalisation service on a cancer-related website.

### 5.3.2. Hypothesis 2.1

The association between *personalisation needs* met and *user background* was limited to the only statistically significant characteristic - *age* (Spearman's  $\rho = 0.236$ ,  $p = 0.039 < 0.05$ ). Thus, H2.1 was partially supported; it implies the older the users, the more likely they are to perceive their personalisation needs have been met on the website.

### 5.3.3. Hypothesis 2.2

The 13 pre-usage emotions did not correlate statistically significantly with the *personalisation needs* met for individual personalisation features offered on the health website; thus, H2.2a was not supported. On the other hand, after Bonferroni corrections ( $p < 0.05/13 = 0.0038$ ), two correlations were found with the factor *personalisation needs*. The emotion found to have a statistically significant positive correlation (Spearman's  $\rho = 0.338$ ,  $p = .003$ ) is the pre-usage *interest*. *Excitement*, pre-usage, was a borderline case, with a positive correlation (Spearman's  $\rho = 0.327$ ,  $p = 0.004$ ). Therefore, it can be claimed, as stated in H2.2, that there are *emotions* which *positively impact* users' perception about the ability of a health website to *meet their personalisation needs*.

### 5.3.4. Hypothesis 3

We hypothesized that in using a personalised health website, post-usage emotions would be affected. In other words, if user's personalisation needs were met, a change in the intensity of emotions would occur, compared to the pre-website usage emotional state. The change in the emotional state of a user was observed in two ways:

- As a difference between the overall emotional state pre- and post-website usage (continuous). The emotional state is calculated as an average of the intensities of the 13 observed emotions;
- As a difference in individual emotions experienced pre- and post-website usage (e.g., to which extent interest was experienced after the website usage, compared to the intensity of the same emotion before using the website, etc.).

In comparing the means of individual emotions before and after website usage, a statistically significant change was seen in 4 emotions, as follows. The negatively valenced emotions - *fear* ( $Z = -2.74$ ,  $p = .006 < .01$ ) and *sadness* ( $Z = -3.117$ ,  $p = .002 < .005$ ), statistically significantly increased after website usage: median fear rating pre-usage = 0 and post-usage = 1, and median sadness rating pre-usage = 1 and post-usage = 2. For positively valenced emotions - *happiness* ( $Z = -2.937$ ,  $p = .003 < .005$ ) and *excitement* ( $Z = -2.607$ ,  $p = .009 < .01$ ), the extent they were experienced before using the

website decreased post-website usage (a change in median value from 4 to 3, and 2 to 1, respectively).

To test the relation between the independent factor *personalisation needs* and the dependent variable *change in the emotional state*, linear regression was used. The regression model, however, was not a good fit of data; *personalisation needs* do not statistically significantly predict a *change in the emotional state* ( $F(1, 73) = 0.3, p > 0.05$ ).

In conclusion, *H3* was partially supported. The results show that a change in intensities of specific emotions occurs between the two stages of usage of the personalised health website. However, further research is needed to understand whether the change is caused by personalisation features or by other website services.

#### 5.3.5. Hypothesis 4.1

Non-parametric test results support this hypothesis. *Re-usage intentions* and *personalisation needs* have a statistically significant, strong positive, correlation (Spearman's  $\rho = 0.581, p = .000 < .001$ ). Therefore, *the more the target website users perceive that the offered features meet their personalisation needs, the greater their intention to subsequently reuse the website*.

#### 5.3.6. Hypothesis 4.2

We first tested emotions experienced before using PORT's website. However, according to the results of multiple regression, these were not good predictors ( $F(13, 55) = 1.09, p = .388 > .05$ ) for *re-usage intentions* of the website. On the other hand, emotions experienced post website usage can predict *re-usage intentions* (Table 1), as shown by the statistically significant results for how well the regression equation fits the data ( $F(13, 63) = 2.48, p = .009 < .01$ ). This finding is more interesting and relevant, since post-usage emotions are those that potentially result from interacting with the website and, thus, are assumed to more likely determine how a user feels about reusing the website.

Variability in emotions experienced after using the website explains 33.8% of variability in *re-usage intentions* ( $R = .582$ ). The statistically significant predictors are: *interest* ( $p = .001$ ) and *excitement* ( $p = .004$ ). Moreover, the *re-usage intentions* factor has a statistically significant relationship with post-usage *interest* (Spearman's  $\rho = .423, p = .000 < .0038$ ). However, correlation with other post-usage emotions was not statistically significant. Overall, *H4.2* was supported: *emotions experienced after website usage can predict the subsequent intention to use a health website*.

**Table 1**

Multiple regression ANOVA results for 13 emotions and re-usage intentions

	Sum of Squares	df	Mean Square	F	Sig.
Regression	23.96	13	1.84	2.48	0.009
Residual	46.89	63	0.74		
Total	70.84	76			

### 5.3.7. Hypothesis 4.2a

A Pearson Chi-Square test was performed to explore the correlation between:

- *Change in emotional state* (post- compared to pre-website usage) – a categorical variable with values: 0 - no change and 1 - change occurred.
- *And Re-usage intentions* – as a categorical variable, representing three groups of users, classified based on their intention to use PORT's website:
  - *No intention to use* – these users expressed disagreement for the majority of items making-up the usage intentions factor (mean value of *Usage intentions*  $\leq 2.5$ ).
  - *Indifferent about usage* – these users were relatively neutral about usage (mean value of *Usage intentions* was between 2.5 and 3.5, exclusive of the border values).
  - *Intending to use* – this group expressed agreement or strong agreement for the majority of the usage intentions items (*Usage intentions*' mean value  $\geq 3.5$ ).

The association between the two categorical variables was statistically significant ( $\chi^2(2) = 6.99$ ,  $p = .03 < .05$ ). Thus, the *vast majority of those who intend to use the website subsequently are the users who experienced a change in the emotional state between pre- and post-website usage*. The same is true in the opposite direction of this relation – 62.3% of users who experienced a change in the emotional state are those who intended to use the website again. Our findings, thus, support *H4.2a - a change in emotional state implies the intention to re-use the health website*.

## 6. Discussion

We have hypothesised that when a person affected by cancer is searching for information online, their background and emotional state impact the want to visit a health website, and in turn will influence their needs for personalisation. But once they engage with a website with personalised services, moreover, those that take into account user emotional states, this would result in a more likely intention to reuse the website. While other user characteristics have been studied in personalised systems, in this paper we argue that it is essential to consider emotions as a potential impacting factor on perceived personalisation needs and usage intentions. This is particularly the case when applied to users of cancer-related health websites, due to the specific, social, physical and mental consequences cancer has on a person's life. The implication of our findings is, therefore, a potential utilization of users' emotional states to predict which personalisation features to offer, and, in turn, increase the intention for subsequent website usage.

We will now discuss the research questions posed at the beginning of this paper. The results of hypotheses' tests were charted in the research model (Fig. 4), to present which relationships (positive or negative) were supported, and which were not found statistically significant (n.s.).

Users of cancer-related websites express satisfaction with all the 24 personalisation features studied here. The mean value of the individual personalisation features was above the neutral 3 for all the 24 features evaluated. Overall, the results for RQ1 show the target users *perceived that the 24 personalisation features* offered on the health website *met their personalisation needs*. The results, however, indicated a need to

explore in more detail the satisfaction of users with 7 features: categorizing and sharing website content, adapting text size and colour, notifications about required actions, content matched to the popular among other users, and personalised e-mail notifications, with regards to whether:

- these features were not noticeable so users failed to interact with them
- the functionality offered did not satisfactorily meet users' personalisation needs
- or these features were simply not perceived as necessary as the remaining 17 for a cancer-related website.

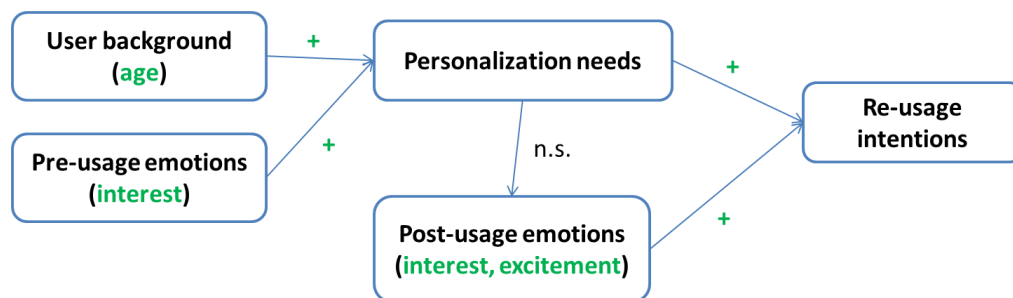


Fig. 4. Research model showing construct relations

In answering RQ2, *background- and emotion-related factors exist, that determine a user's perception that their personalisation needs have been met*. Age is associated with personalisation needs - the older the user, the more likely they are to agree that their personalisation needs have been met on the health website. Younger users are, perhaps, more tech-savvy and, therefore, more demanding with regards to the features and services they are offered.

Moreover, *certain pre-usage emotions impact the perceived personalisation needs*. In fact, when experiencing *interest* at the start of website usage, the greater its intensity, the more the personalisation features interacted with are perceived as having met users' needs, and vice-versa. If users were interested in a website to begin with, they would find that the website met their personalisation needs. The presumption is that interest stimulates curiosity when using a health website and, possibly, increases lenience toward the offered personalisation features.

The remaining 12 pre-usage emotions did not show a statistically significant association with the factor personalisation needs or with the individual 24 personalisation features. Therefore, further tests have to be performed, with larger samples, to draw more reliable conclusions about the relations between these factors. Nevertheless, there is ground for expanding user models for personalization of health websites. It is, however, a matter of whether to explore the effects of overall emotional states – as valence and arousal, or have more granularity by looking at specific emotions, and which these would be.

Our findings for RQ3 imply that using a personalised health website can induce a change in the emotions' intensity between pre- and post-website usage. This is evident for: *fear*, *sadness*, *happiness* and *excitement*. The former two increase in intensity, and the latter two decrease. The reasoning could be found in the content type provided on cancer-related websites. Cancer-related information potentially encourages the growth of fear and sadness (negatively valenced emotions). On the other hand, it has an opposite



effect on a user's initial level of happiness and excitement (positively valenced). However, the change could have also resulted from the interaction with website's personalisation features. To understand the exact cause of the change, further research is needed.

The last RQ asked about the *factors influencing re-usage intentions*, in order to *improve online support* available to people affected by cancer, *and thus increase users' willingness to reuse and engage with these services*. As expected, personalisation needs and post-usage emotions (especially positive emotions, such as interest and excitement), have a positive influence on usage intentions. Our results suggest that *emotions play a role in a user's intention to revisit a cancer-related website*. Primarily, a change in the overall emotional state increases the likelihood of the intent to reuse a cancer-related website. Secondly, usage intentions are positively associated with the emotion *interest*. Finally, emotions (*interest* and *excitement*) a user exhibits after completing a visit to a cancer-related website can predict his/her usage intentions.

*Interest* is also the emotion which correlates with the perception on website's ability to meet their personalisation needs. Both *interest* and *excitement* are indicative of a positive attitude toward exploring and tailoring the website (as instructed in the study's experiment, e.g., in using the features: user profile customisation, tailoring website background, adapting text size and colour, etc.). It can be assumed that, the greater the intensity of these emotions, the more likely a user is to explore the website and its features, have a positive perception about the personalisation offered, and, thereby, be more willing to use the website again. Therefore, website providers should focus on detecting such emotional states at the start of website usage. Moreover, to induce users who are in these emotional states to revisit the website, the content and personalised services provided on the website should work at increasing the intensity of emotions with a positive valance, and decreasing the negatively valenced ones (e.g., fear and sadness). This could be accomplished by presenting specific type of content (such as images, videos, etc.), focusing more on articles-, blogs-, or forum-related content, or highlighting specific types of personalisation features, that have been shown to induce positively valenced emotions.

In order to observe the effect of emotions on the choice of content to visit, as well as vice versa - the effect that the presented content and features have on the emotional state, as reported by the user - a tracking interface was newly introduced on PORT's website (available at: <http://new.port.org.ba/>). The "emotion tool" is an instrument for collecting user emotions at every stage of a website visit. This study also faced several limitations that *future studies* should consider. For instance, to conduct a more reliable evaluation of effectiveness of certain personalisation features, long-term usage and user behaviour will be observed and recorded through the website. The second phase of website development was completed in March 2015, based on the findings presented in this paper, and the website is currently undergoing the third phase of development.

## 7. Conclusion

The research reviewed for this study implied there still exists a gap in personalising online health services, in particular compared to certain other online services. There is a lack of comprehensive understanding about which personalisation features users of cancer-related websites need and prefer. To research these assumptions, the study was performed in B&H, which offered an untainted environment, not affected by previous attempts of health website personalisation, which was needed for understanding user

preferences and interaction between the research factors studied here. The sample was drawn from one country; nevertheless, the findings are more broadly applicable. As explained in Section 2, even within the European context, to which B&H also belongs based on its socio-geographical characteristics, there is still a lack of personalised online health services.

Two main aims guided this research:

- discovering the factors that can be incorporated into user models to improve personalisation, in particular the connection between emotions and personalisation needs.
- understanding the factors, in particular emotion-related, that can predict subsequent intention to use a health website.

Personalisation features on cancer-related websites satisfy target users' needs. This perception was exhibited across all 24 features studied here (Fig. 3); however, several features had more pronounced neutral perception among users. Thus, a better understanding is required whether to provide them on such health websites. Overall, nonetheless, it can be interpreted that personalisation services are desired, and the ones studied here seem to meet users' personalisation needs.

Personalisation needs of target users are affected by their age and positive emotions they experience before coming to a website (interest and excitement). While age is a user characteristics often considered in user models for personalised systems, emotions are not. Our results suggests that user models could be expanded with user emotional states, and further research should be undertaken to explore the possibility of utilizing emotional state to predict the personalisation features to offer on a health website.

In relation to the second direction of this paper, user's perception about whether their needs for personalisation have been met, and emotions they feel after visiting the website, can predict website re-usage intentions. Therefore, to *improve online support* available to people affected by cancer, and *encourage future website usage*, website providers should:

- improve users' perception about the website's ability to meet their personalisation needs, and, furthermore,
- induce positive emotions during website usage (*interest and excitement*).

The fact that there are some emotions, such as *pre-usage interest*, and *post-usage interest* and *excitement*, that do impact user's perception about a website's personalisation and their intention to use the website again, shows that it is necessary to further study the effect of emotions on health websites' personalisation services. Emotions, thus, can be the means to build more comprehensive and powerful user models for users affected by cancer, and overall improve the usability of online health services.

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